

WHAT IS CLAIMED IS:

1. Apparatus for removing particles from a surface of an article to be cleaned, said apparatus comprising:
 - 3 a pump; and
 - 4 a first tube or slot connected at one end to said pump so as to create a flow of a first gas in said first tube or slot, and having the other end substantially facing said surface;
 - 7 wherein a juxtaposition of said end and said surface, together with
 - 8 said flow of said first gas in said first tube or slot, forms a shock wave sufficient to
 - 9 dislodge said particles from said surface of said article.
1. 2. An apparatus as claimed in claim 1, wherein said flow of said first gas in said first tube or slot results from a pressure differential between an inside of said first tube or slot, and an outside of said first tube or slot.
1. 3. An apparatus as claimed in claim 2, wherein said pressure differential is such that a pressure in said first tube or slot is less than a pressure outside of said first tube or slot.
1. 4. An apparatus as claimed in claim 3, wherein said pump is a vacuum pump.
1. 5. An apparatus as claimed in claim 2, wherein said pressure differential is such that a pressure in said first tube or slot is greater than a pressure outside of said first tube or slot.
1. 6. An apparatus as claimed in claim 5, wherein said pump pumps gas into said first tube or slot.
1. 7. An apparatus as claimed in claim 1, further comprising means for effecting relative movement between said first tube or slot and said surface.
1. 8. An apparatus as claimed in claim 7, wherein said means for effecting relative movement comprises means for moving said first tube or slot across said surface in raster fashion.
1. 9. An apparatus as claimed in claim 7, wherein said means for effecting relative movement comprises means for rotating said article, and means for

3 passing said first tube or slot between a center of said article and a perimeter of
4 said article.

1 10. An apparatus as claimed in claim 7, wherein said means for effecting
2 relative movement causes relative movement between one or more particular areas
3 of said surface, and said first tube or slot.

1 11. An apparatus as claimed in claim 10, whereby one or more particular areas
2 of said surface are cleaned to a greater extent than other areas of said surface.

1 12. An apparatus as claimed in claim 1, wherein a tip of said other end of said
2 first tube or slot has one of a half-conical shape, a truncated half-conical shape, a
3 conical shape, or a rounded shape.

1 13. An apparatus as claimed in claim 1, wherein said other end of said first
2 tube or slot is disposed so as to form a predetermined gap between said surface
3 and said first tube or slot, said shock wave being formed in said gap.

1 14. An apparatus as claimed in claim 1, further comprising a further tube or
2 slot, concentric with and inside said first tube or slot, for providing a flow of a
3 second gas toward said surface of said article, said shock wave being formed by
4 flow of said second gas in said first tube or slot.

1 15. An apparatus as claimed in claim 14, wherein said second gas is the same
2 as said first gas.

1 16. An apparatus as claimed in claim 14, wherein a vacuum is formed in said
2 further tube or slot.

1 17. An apparatus as claimed in claim 1, further comprising a plurality of said
2 tubes or slots, each having a respective end substantially facing said surface, and
3 each of said tubes or slots having a pressure within that is sufficiently different
4 from a pressure without to form a shock wave at said respective end.

1 18. An apparatus as claimed in claim 1, further comprising a further tube or
2 slot juxtaposed with respect to an opposite surface of said article from said first
3 tube or slot so as to effect cleaning of said surface and said opposite surface.

1 19. An apparatus as claimed in claim 1, wherein said article is a
2 semiconductor wafer.

1 20. An apparatus as claimed in claim 1, wherein said article is a reticle.

1 21. A method of removing particles from a surface of an article to be cleaned,
2 said method comprising providing a first tube or slot with one end connected to a
3 pump and the other end disposed substantially facing said surface, and providing a
4 flow of a first gas in said first tube or slot so as to induce a pressure differential
5 between an inside of said first tube or slot, and an outside of said first tube or slot,
6 said pressure differential forming a shock wave sufficient to dislodge said
7 particles from said surface.

1 22. A method as claimed in claim 21, wherein providing said flow of said first
2 gas comprises reducing a pressure in said first tube or slot with respect to a
3 pressure outside of said first tube or slot.

1 23. A method as claimed in claim 21, wherein providing said flow of said first
2 gas comprises increasing a pressure in said first tube or slot with respect to a
3 pressure outside of said first tube or slot.

1 24. A method as claimed in claim 21, further comprising effecting relative
2 movement between said first tube or slot and said surface.

1 25. A method as claimed in claim 24, wherein said effecting relative
2 movement comprises moving said first tube or slot across said surface in raster
3 fashion.

1 26. A method as claimed in claim 24, wherein said effecting relative
2 movement comprises rotating said article, and passing said first tube or slot
3 between a center of said article and an external perimeter of said article.

1 27. A method as claimed in claim 24, wherein said effecting relative
2 movement causes relative movement between one or more particular areas of said
3 surface, and said tube or slot.

1 28. A method as claimed in claim 27, whereby one or more particular areas of
2 said surface are cleaned to a greater extent than other areas of said surface.

1 29. A method as claimed in claim 21, wherein said providing said first tube or
2 slot comprises disposing said other end so as to form a predetermined gap

3 between said surface and said first tube or slot, said shock wave being formed in
4 said gap.

1 30. A method as claimed in claim 21, further comprising providing a further
2 tube or slot, concentric with and inside said first tube or slot, for providing a flow
3 of a second gas within said further tube or slot, said shock wave being formed by
4 flow of said second gas in said first tube or slot.

1 31. A method as claimed in claim 30, wherein said second gas is the same as
2 said first gas.

1 32. A method as claimed in claim 30, further comprising forming a vacuum in
2 said further tube or slot.

1 33. A method as claimed in claim 21, further comprising providing a plurality
2 of said tubes or slots, each of said tubes or slots having a respective end
3 substantially facing said surface, each of said tubes or slots having a pressure
4 within that is sufficiently different from a pressure without to form a shock wave
5 at said respective end.

1 34. A method as claimed in claim 21, further comprising providing a further
2 tube or slot juxtaposed with respect to an opposite surface of said article from said
3 first tube or slot so as to effect cleaning of said surface and said opposite surface.

1 35. A method as claimed in claim 21, wherein said article is a semiconductor
2 wafer.

1 36. A method as claimed in claim 21, wherein said article is a reticle.